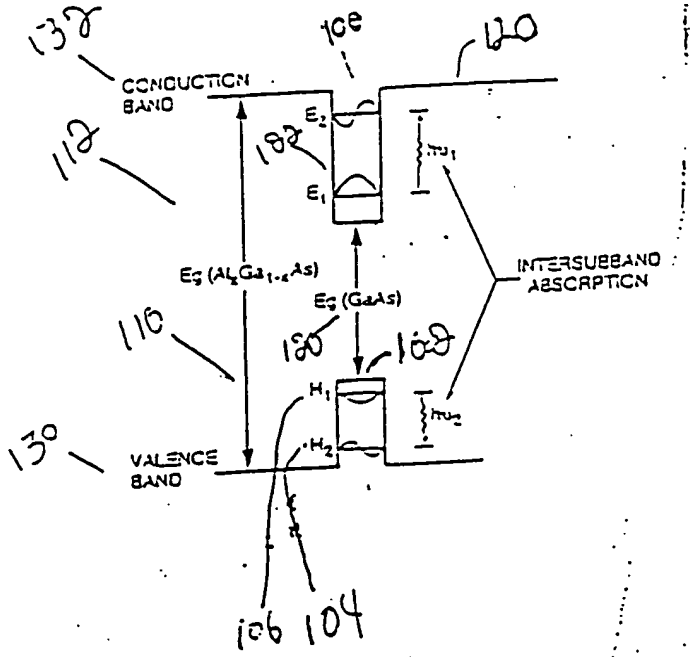

138
108
120
CONDUCTION BAND
112
182
E_2
E_1
$E_g(Al_xGa_{1-x}As)$
$E_g(GaAs)$
INTERSUBBAND ABSORPTION
110
180
100
H_1
H_2
130
VALENCE BAND
106
104

FIG 1

0050-1250

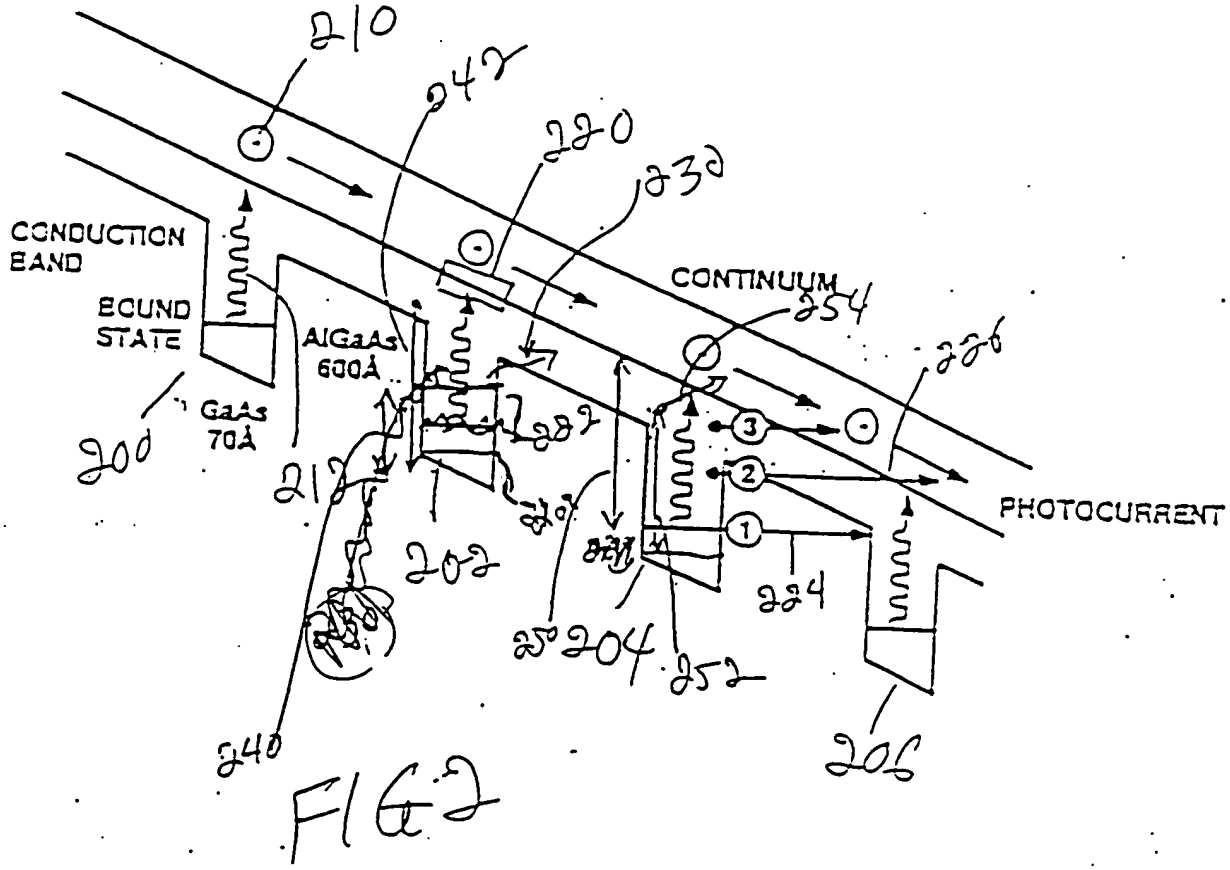
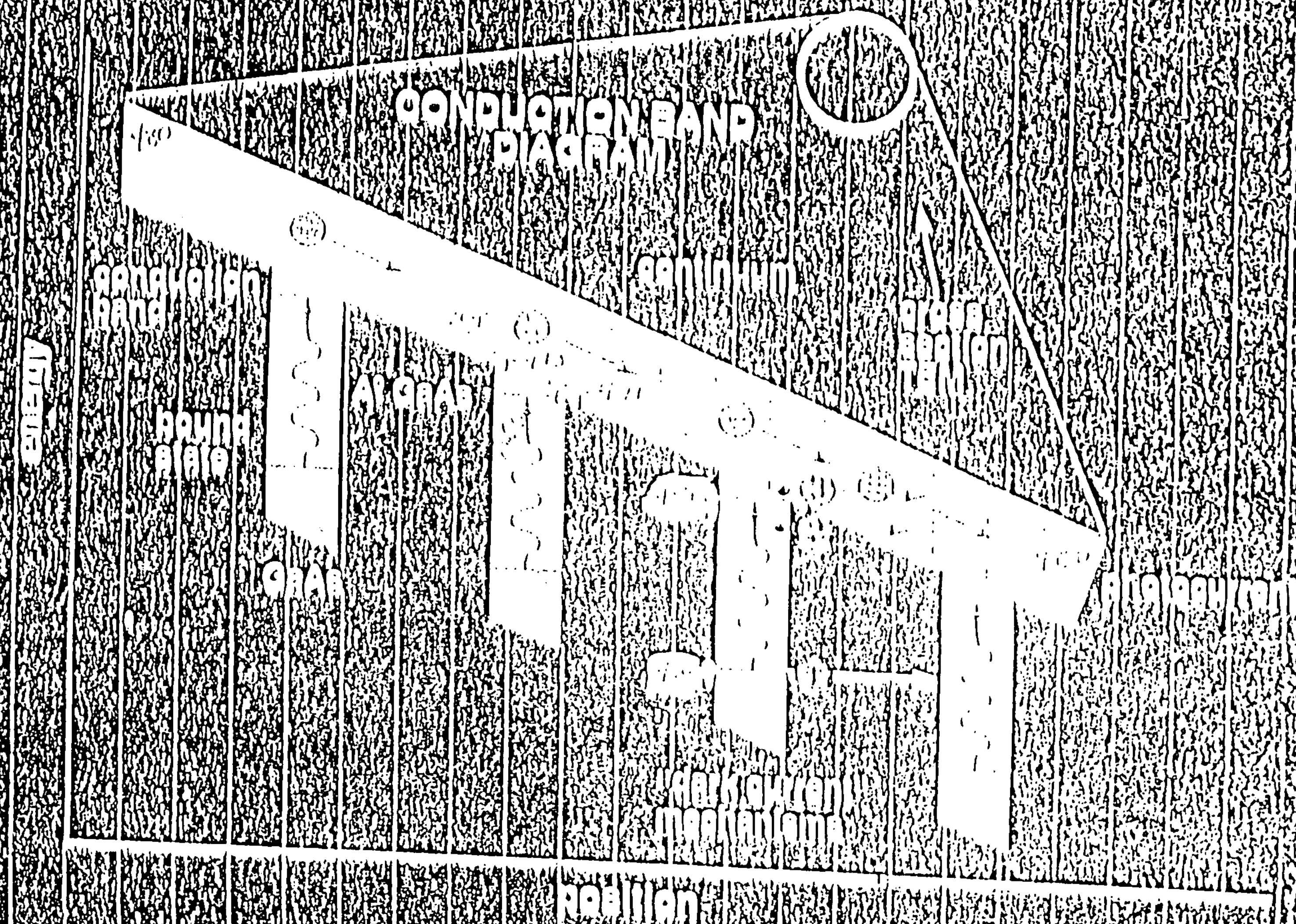


FIG 2

09305121.050499

JPL Bound-to-Quasibound QWIP



6648650 - 12/14/2020

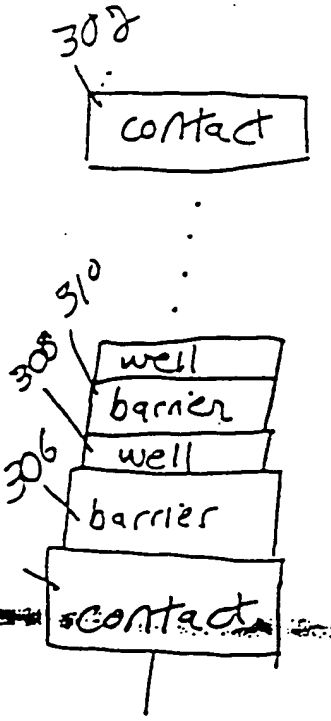


FIG3B

(a)

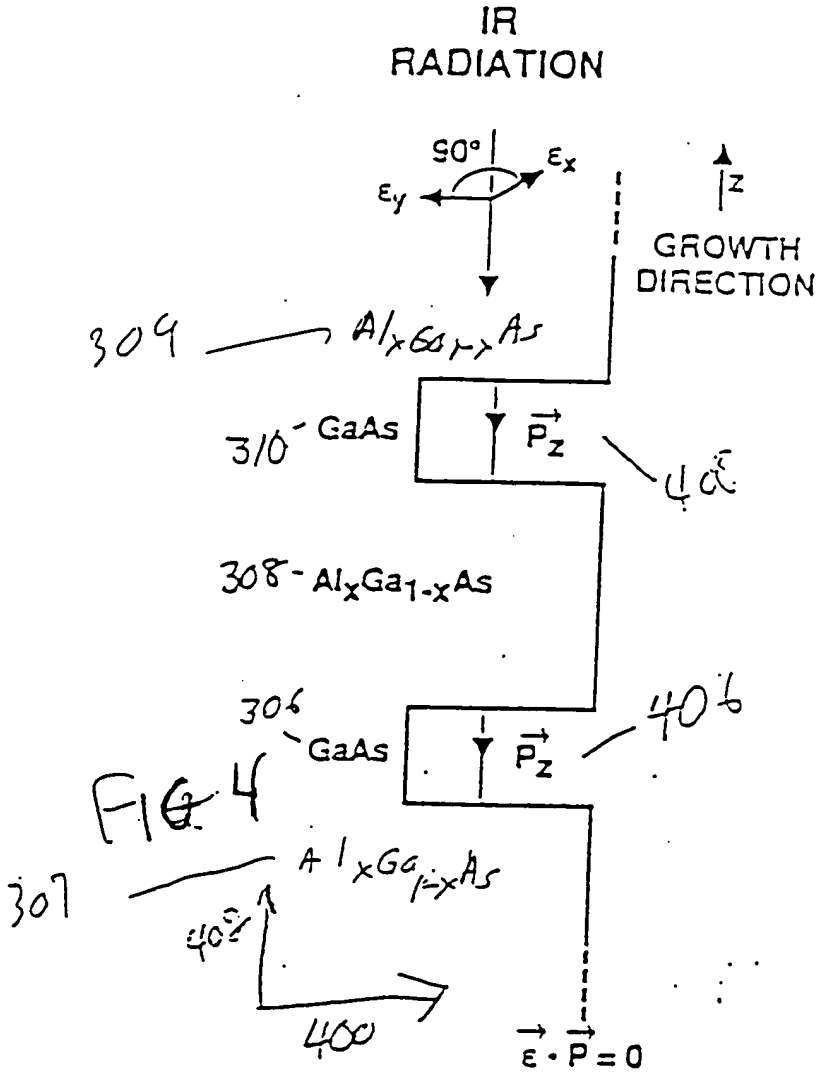

IR
RADIATION
90°
ε_x
ε_y
z
GROWTH
DIRECTION
309
$Al_xGa_{1-x}As$
310
GaAs
$\vec{P}_z$
408
308
$Al_xGa_{1-x}As$
306
GaAs
$\vec{P}_z$
406
307
$Al_xGa_{1-x}As$
402
400
$\vec{\varepsilon} \cdot \vec{P} = 0$

FIG 4

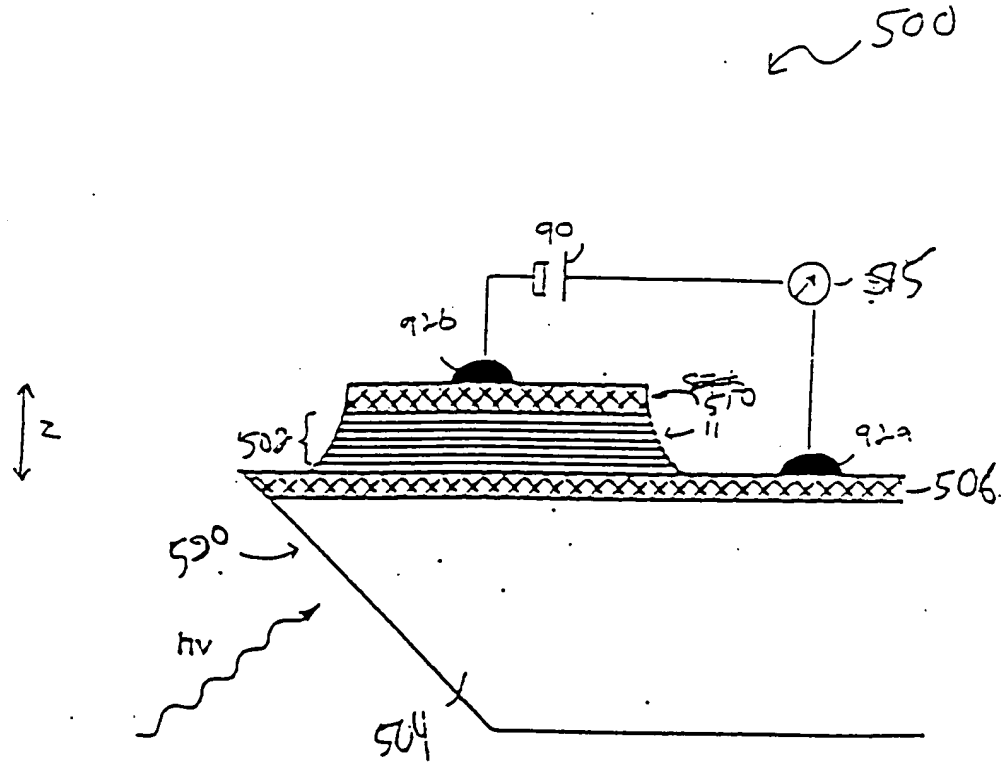


FIG 5

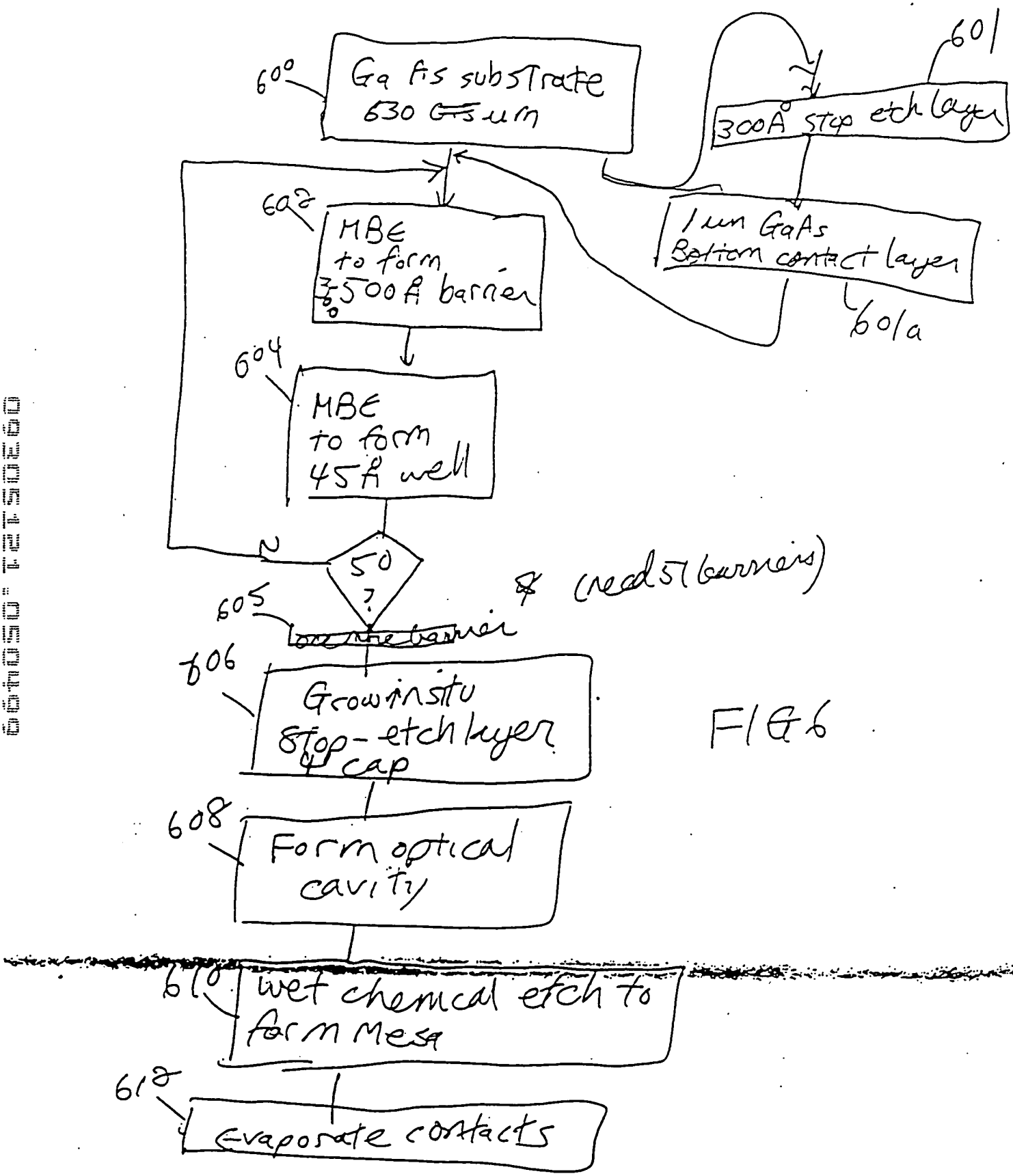

600
GaAs substrate
630 ~~μm~~ μm
601
300Å stop etch layer
1 μm GaAs
Bottom contact layer
601a
602
MBE
to form
3500Å barrier
604
MBE
to form
45Å well
50
?
& (need 51 barriers)
605
~~last barrier~~
606
Grow in situ
stop-etch layer
& cap
608
Form optical
cavity
610
wet chemical etch to
form Mesa
612
Evaporate contacts

FIG 6

A

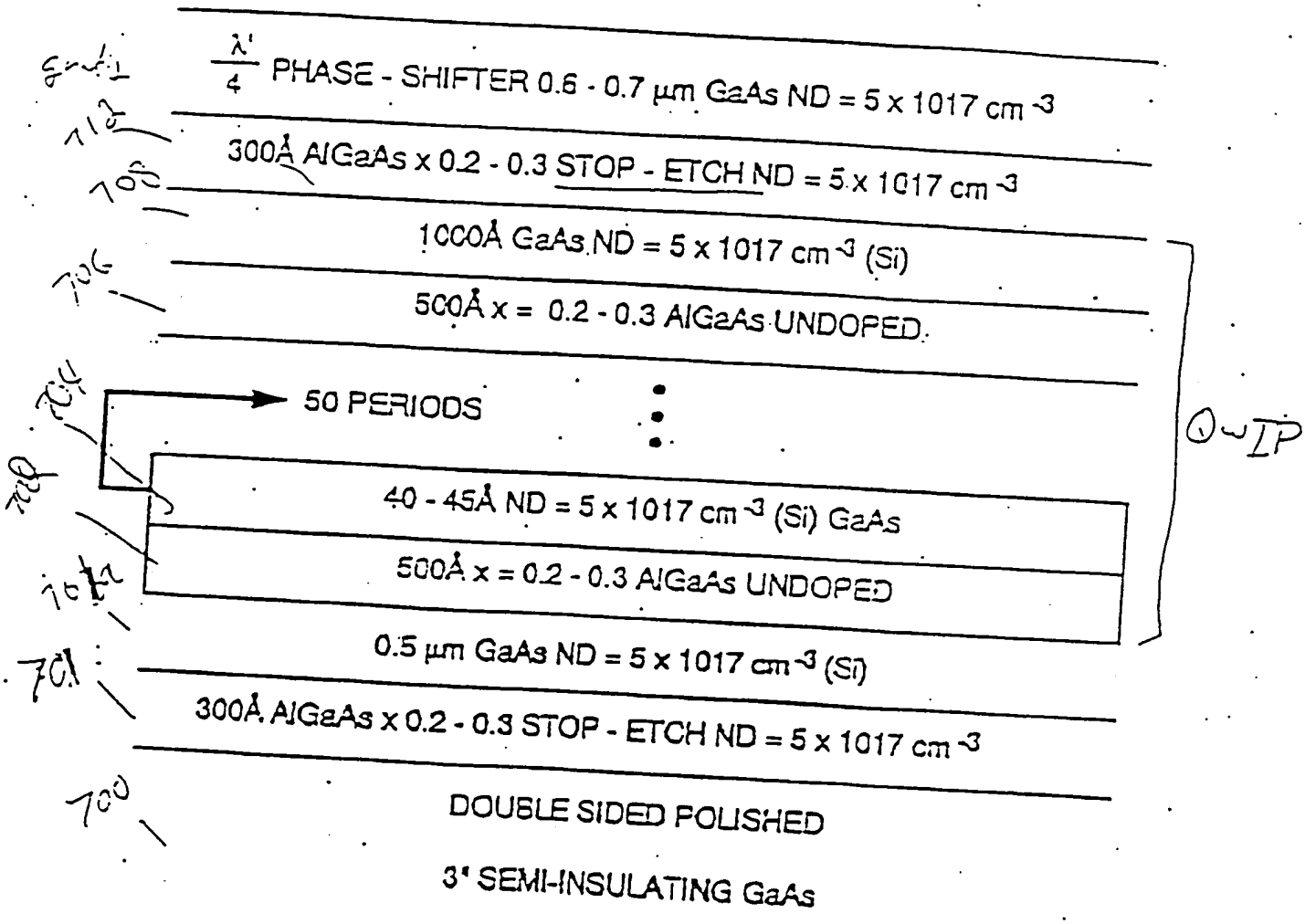

$\frac{\lambda'}{4}$ PHASE - SHIFTER 0.6 - 0.7 μm GaAs ND = 5 x 1017 cm -3
300Å AlGaAs x 0.2 - 0.3 STOP - ETCH ND = 5 x 1017 cm -3
1000Å GaAs ND = 5 x 1017 cm -3 (Si)
500Å x = 0.2 - 0.3 AlGaAs UNDOPED
50 PERIODS
40 - 45Å ND = 5 x 1017 cm -3 (Si) GaAs
500Å x = 0.2 - 0.3 AlGaAs UNDOPED
0.5 μm GaAs ND = 5 x 1017 cm -3 (Si)
300Å AlGaAs x 0.2 - 0.3 STOP - ETCH ND = 5 x 1017 cm -3
DOUBLE SIDED POLISHED
3" SEMI-INSULATING GaAs
QWIP

FIG 7

Fig 7A

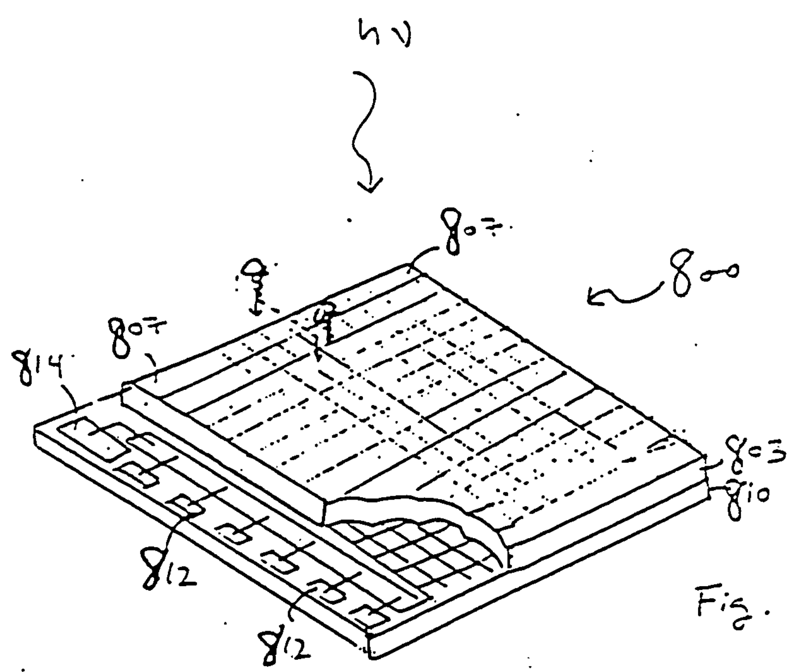


Fig. 8

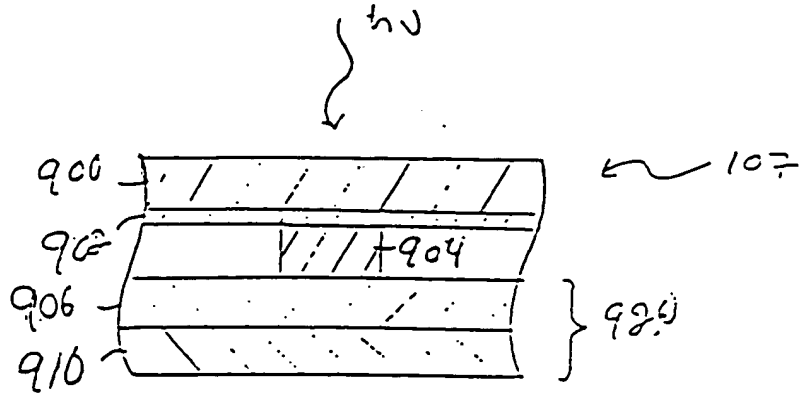
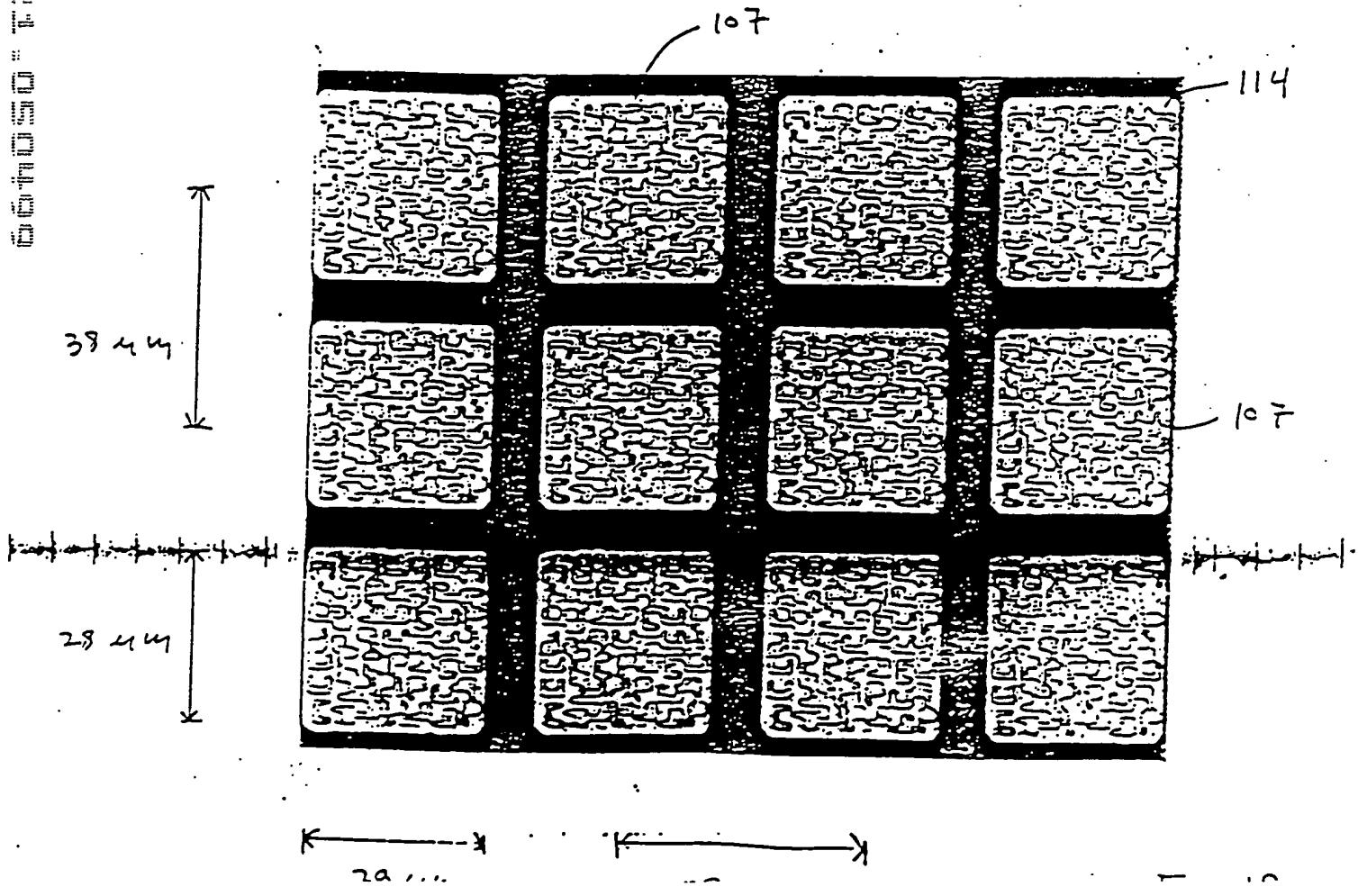


Fig. 9



2-D GRATING OPTIMIZATION

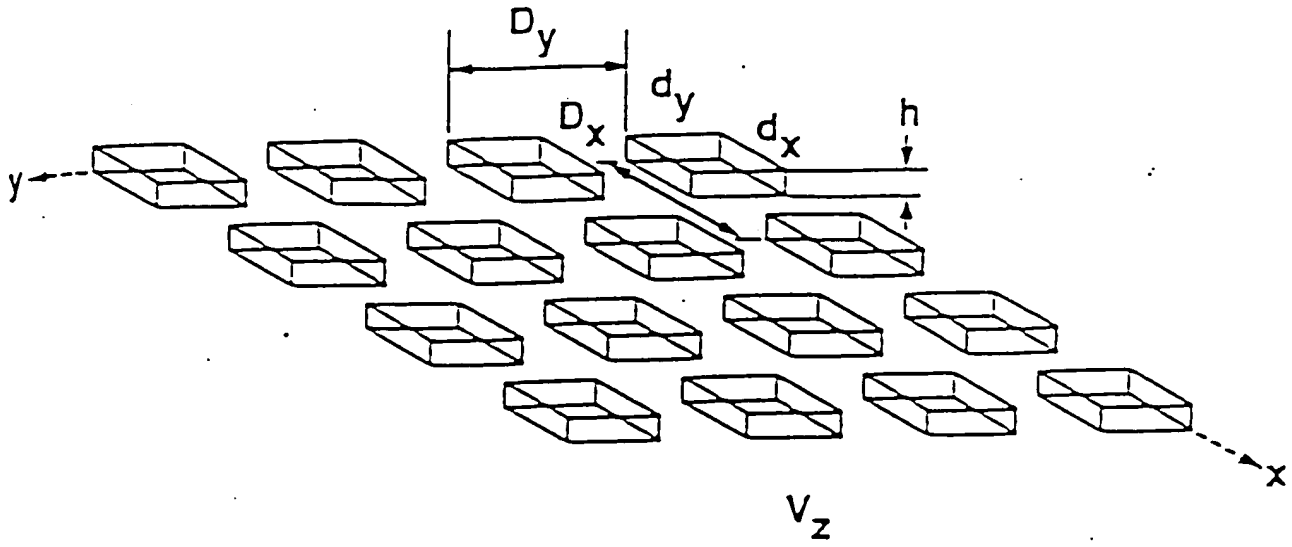


FIG 10A

FIG. 1

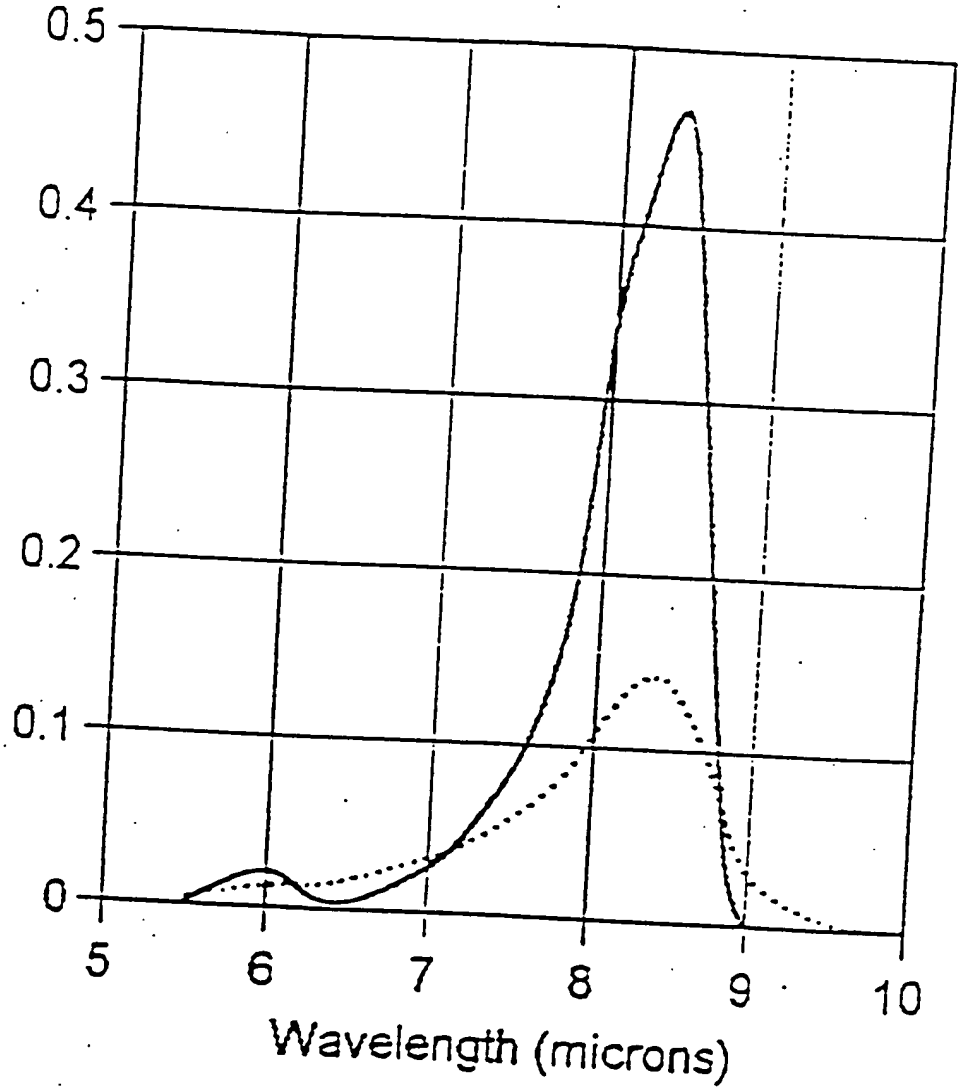

0.5
0.4
0.3
0.2
0.1
0
5
6
7
8
9
10
Quantum Efficiency
Wavelength (microns)

FIG 10B

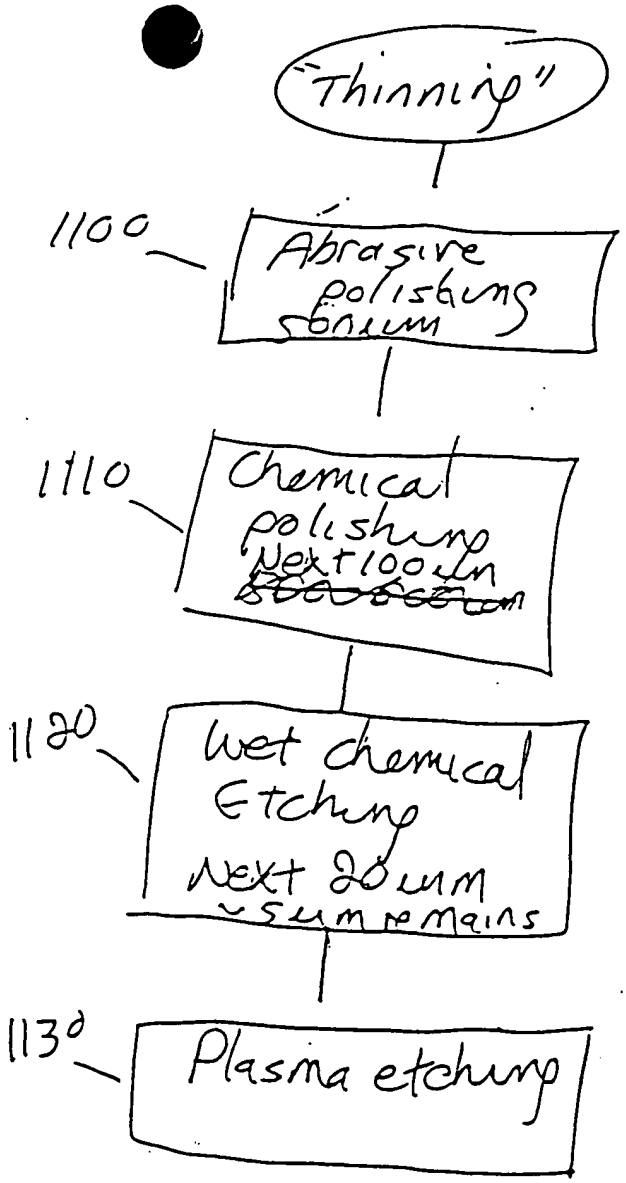

"Thinning"
1100
Abrasive polishing
1110
Chemical polishing
Next 100 um
1120
Wet chemical Etching
Next 20 um
~5 um remains
1130
Plasma etching

FIG 11

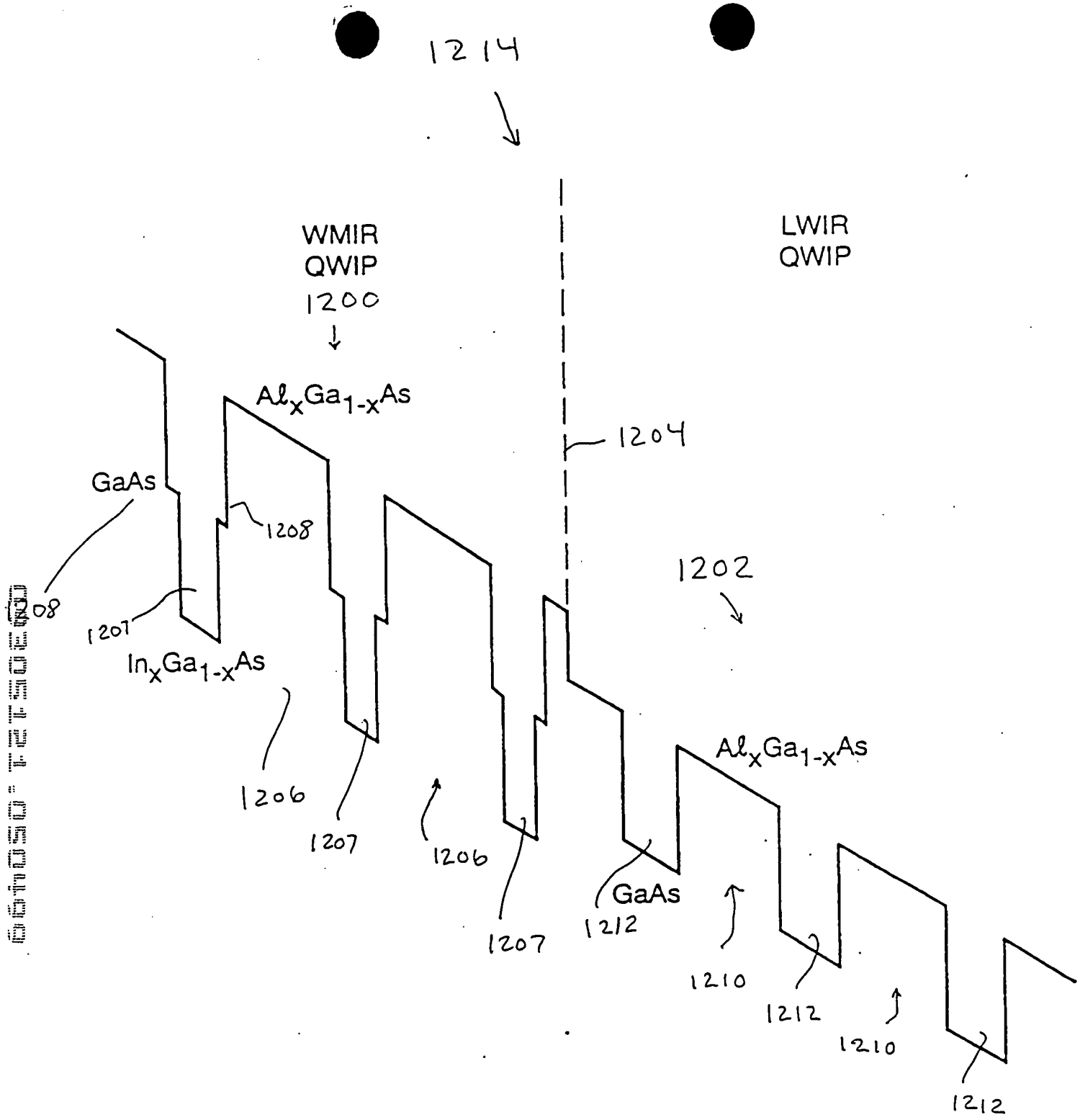

1214
WMIR
QWIP
1200
LWIR
QWIP
$Al_xGa_{1-x}As$
1204
GaAs
1208
1208
1207
$In_xGa_{1-x}As$
1202
1206
1207
1206
$Al_xGa_{1-x}As$
GaAs
1212
1207
1210
1212
1210
1212

FIG 12

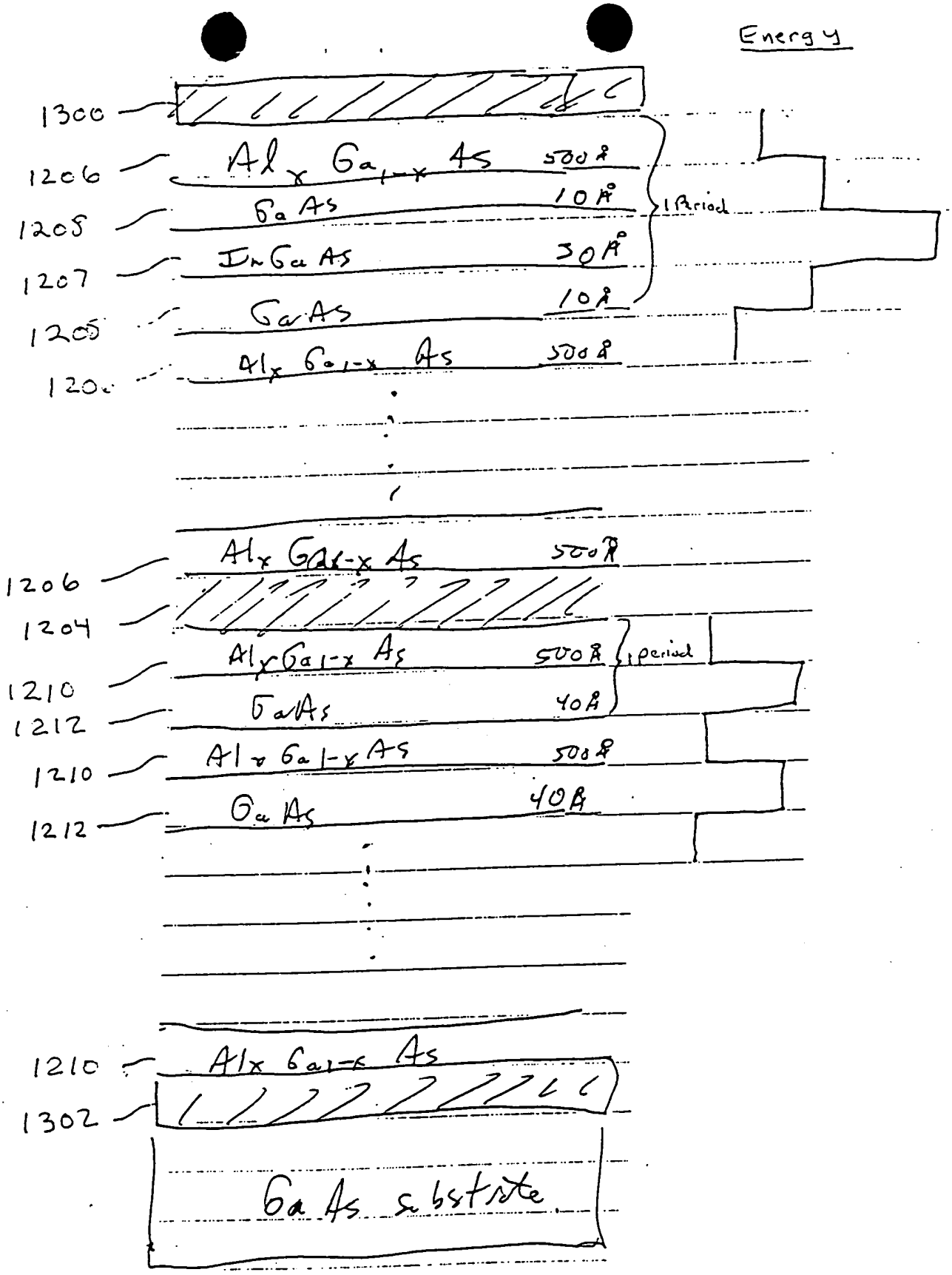

Energy
1300
1206
$Al_x Ga_{1-x} As$
500 Å
1205
GaAs
10 Å
1 Period
1207
$In_x Ga As$
30 Å
1205
GaAs
10 Å
1206
$Al_x Ga_{1-x} As$
500 Å
1204
1210
$Al_x Ga_{1-x} As$
500 Å
1 period
1212
GaAs
40 Å
1210
$Al_x Ga_{1-x} As$
500 Å
1212
GaAs
40 Å
1210
$Al_x Ga_{1-x} As$
1302
GaAs substrate

FIG 13

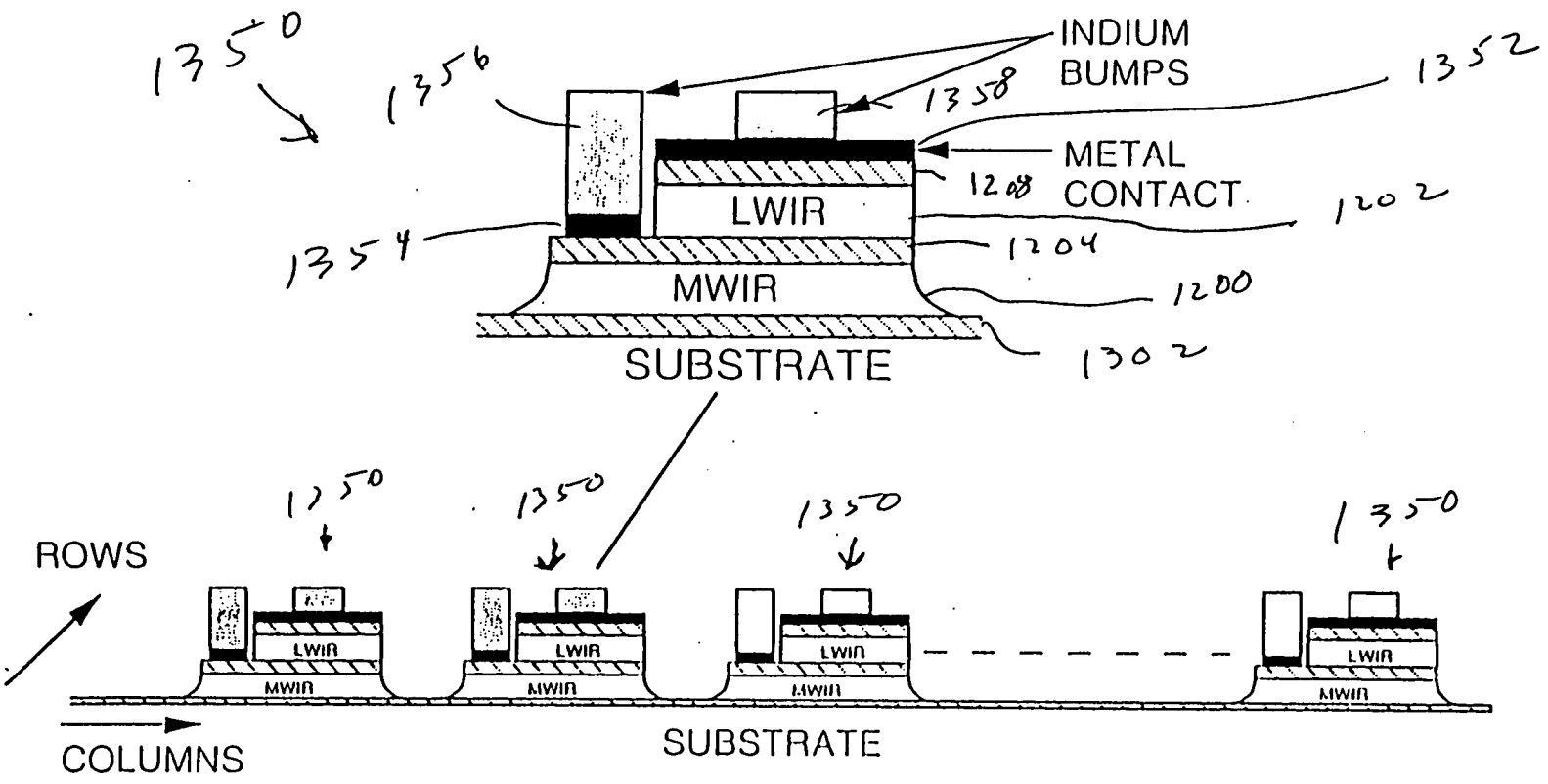

1350
1356
INDIUM BUMPS
1358
1352
METAL CONTACT
1208
LWIR
1202
1354
1204
MWIR
1200
SUBSTRATE
1302
1350
1350
1350
1350
ROWS
LWIR
MWIR
COLUMNS
SUBSTRATE

FIG 14

512 x 484 TWO COLOR QWIP FOCAL PLANE ARRAY

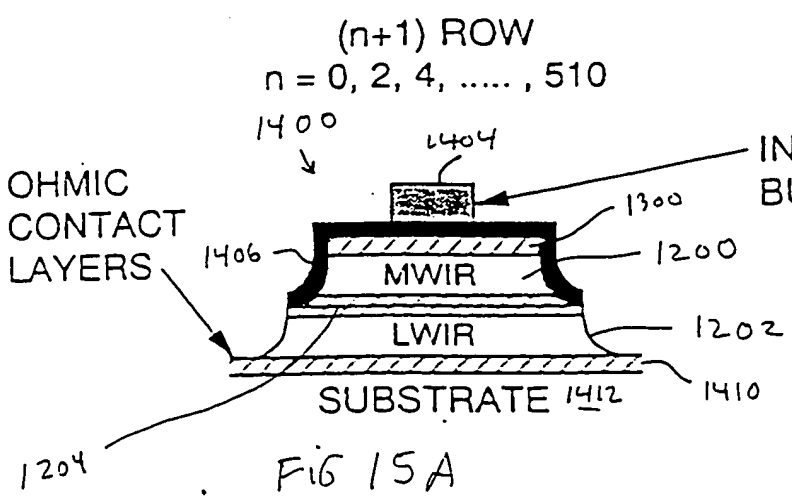


FIG 15A

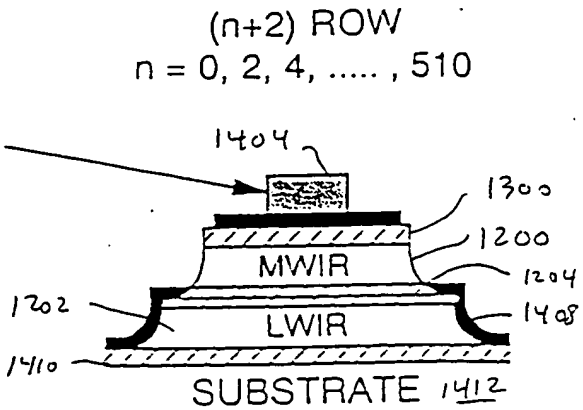


FIG 15B

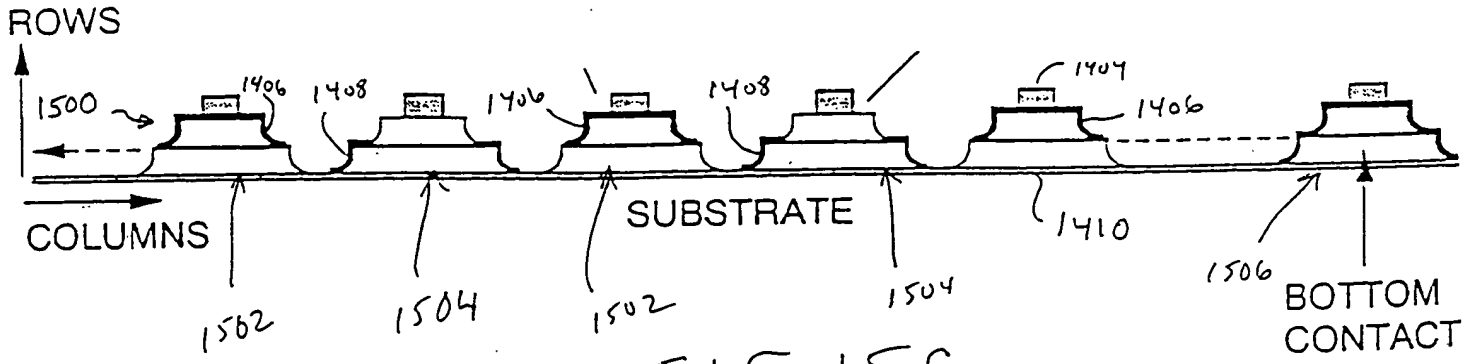


FIG 15C

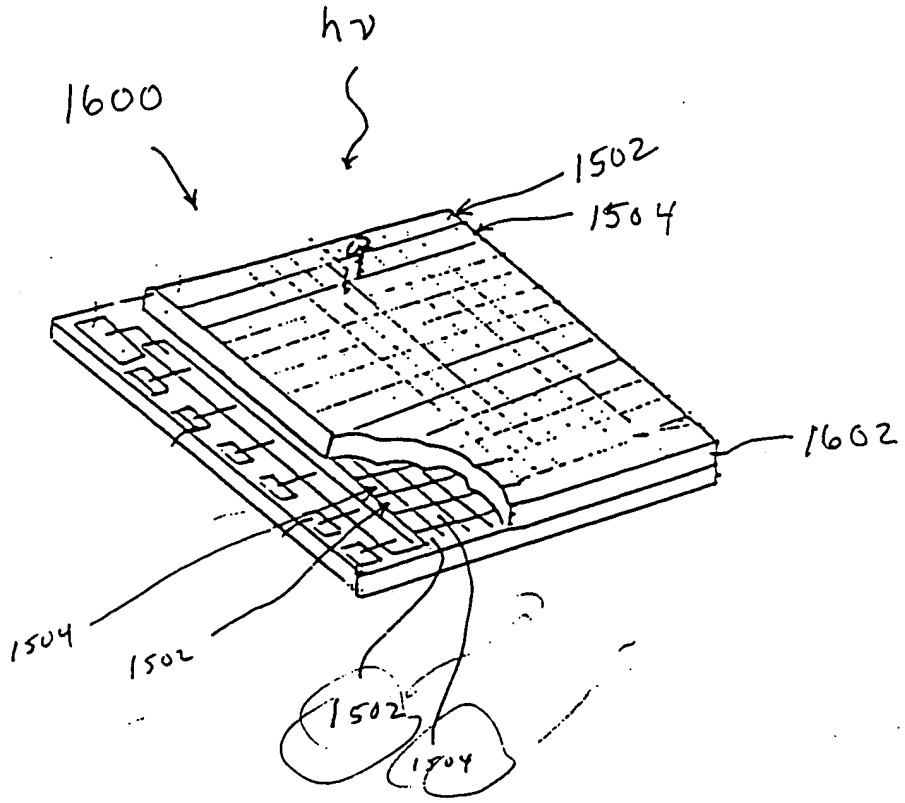


FIG 16

6611050 "T2T50E60

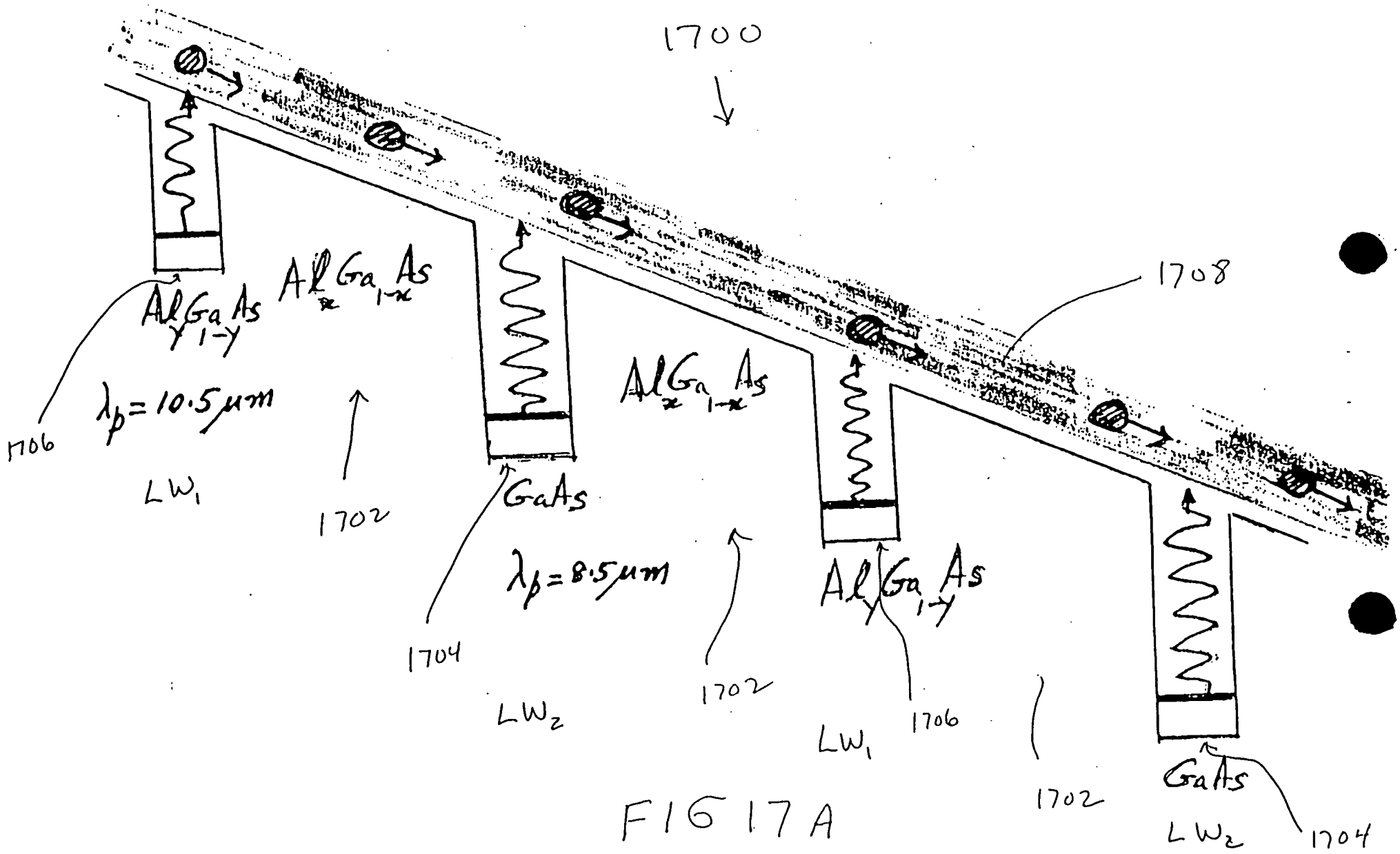


FIG 17A

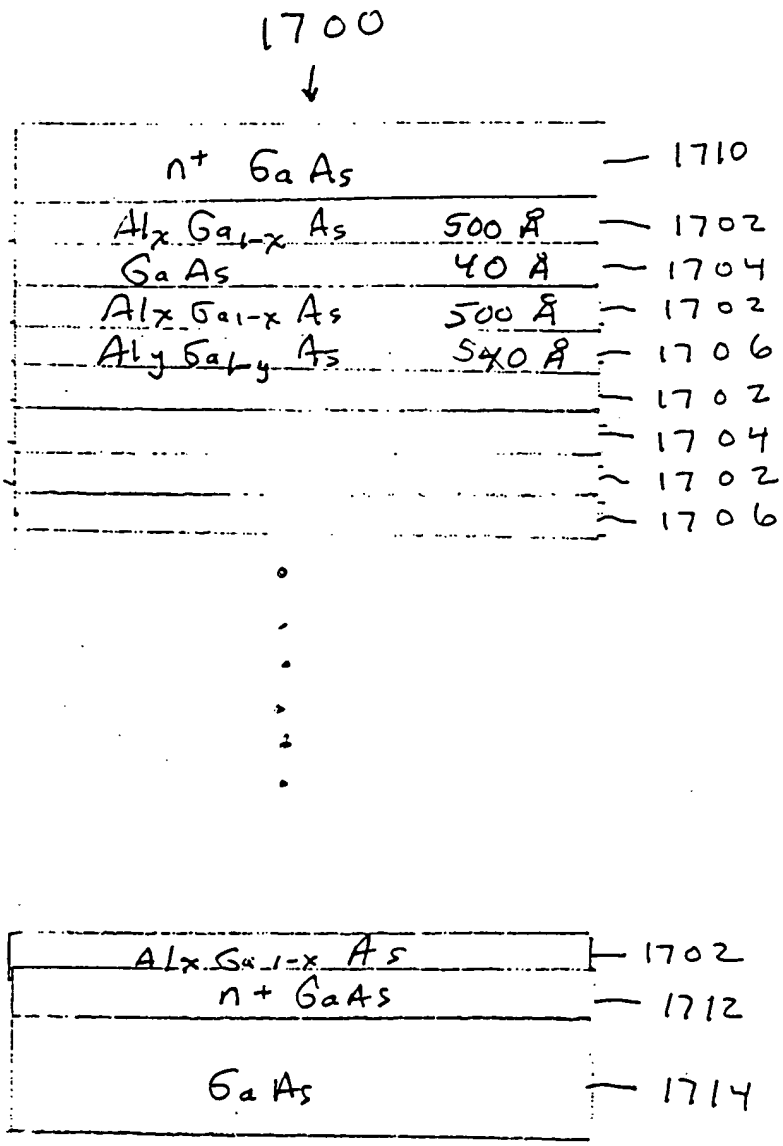
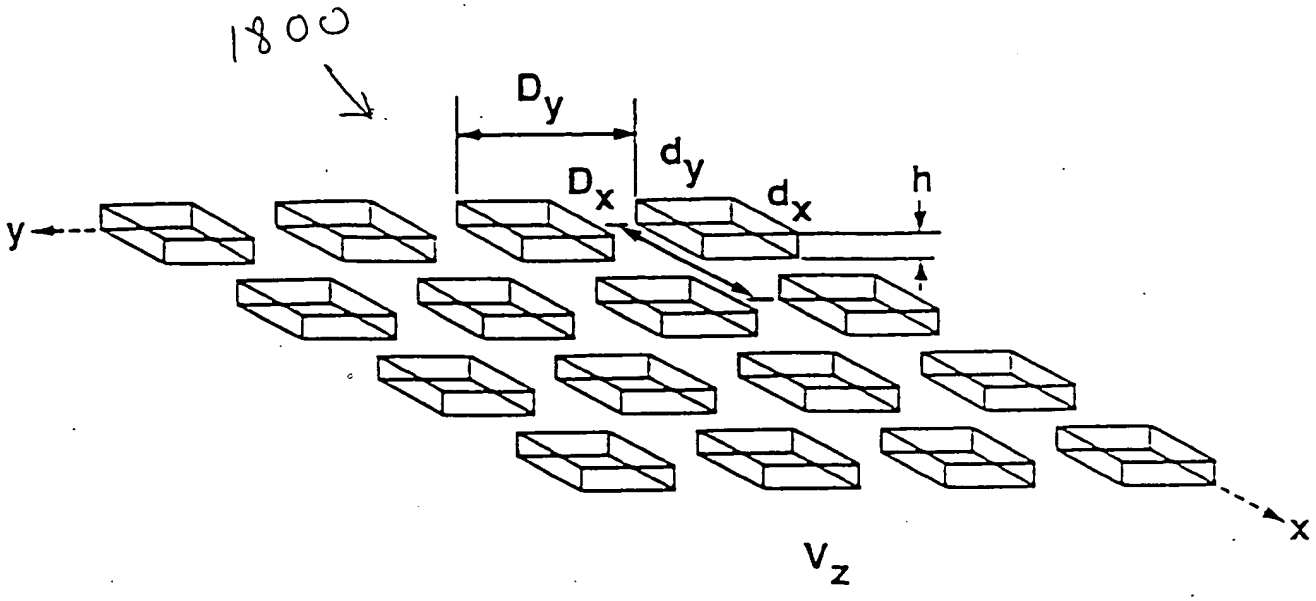

1700
n+ GaAs
1710
AlxGa1-xAs 500 Å
1702
GaAs 40 Å
1704
AlxGa1-xAs 500 Å
1702
AlyGa1-yAs 540 Å
1706
1702
1704
1702
1706
AlxGa1-xAs
1702
n+ GaAs
1712
GaAs
1714

FIG 17B

2-D GRATING OPTIMIZATION



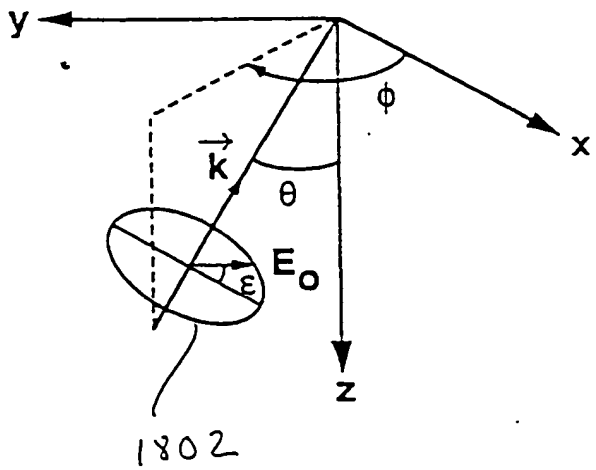
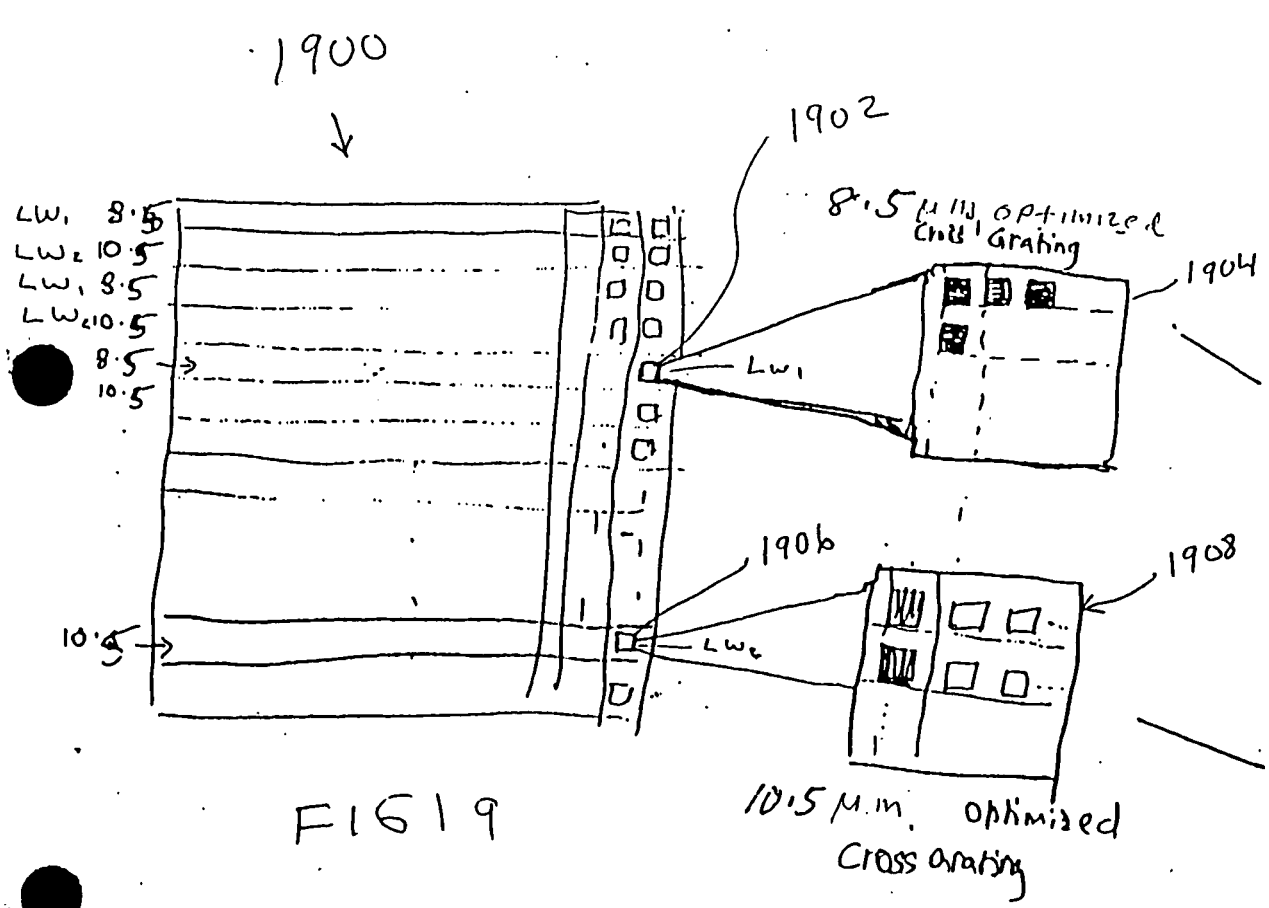


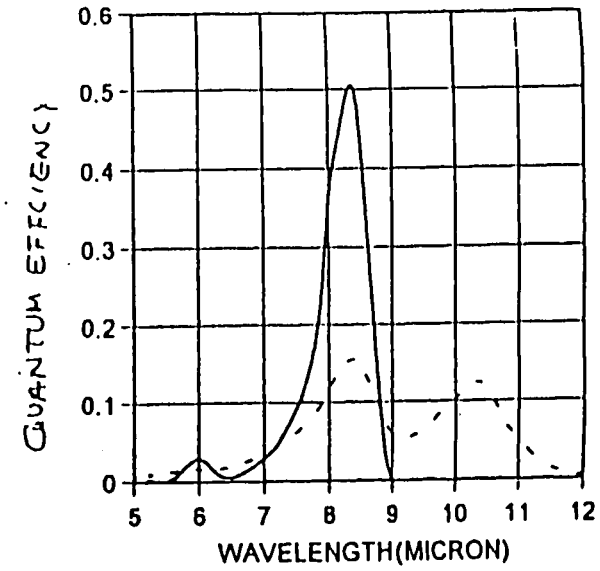
FIG 18

DUAL WAVELENGTH FOCAL PLANE ARRAY

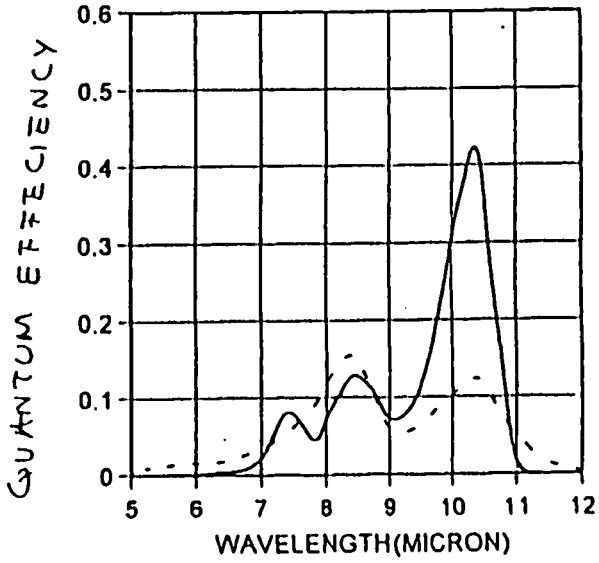


F16 19

Focal plane Array.



F16 20



F16 21

09305121 .050409